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ERRATA.

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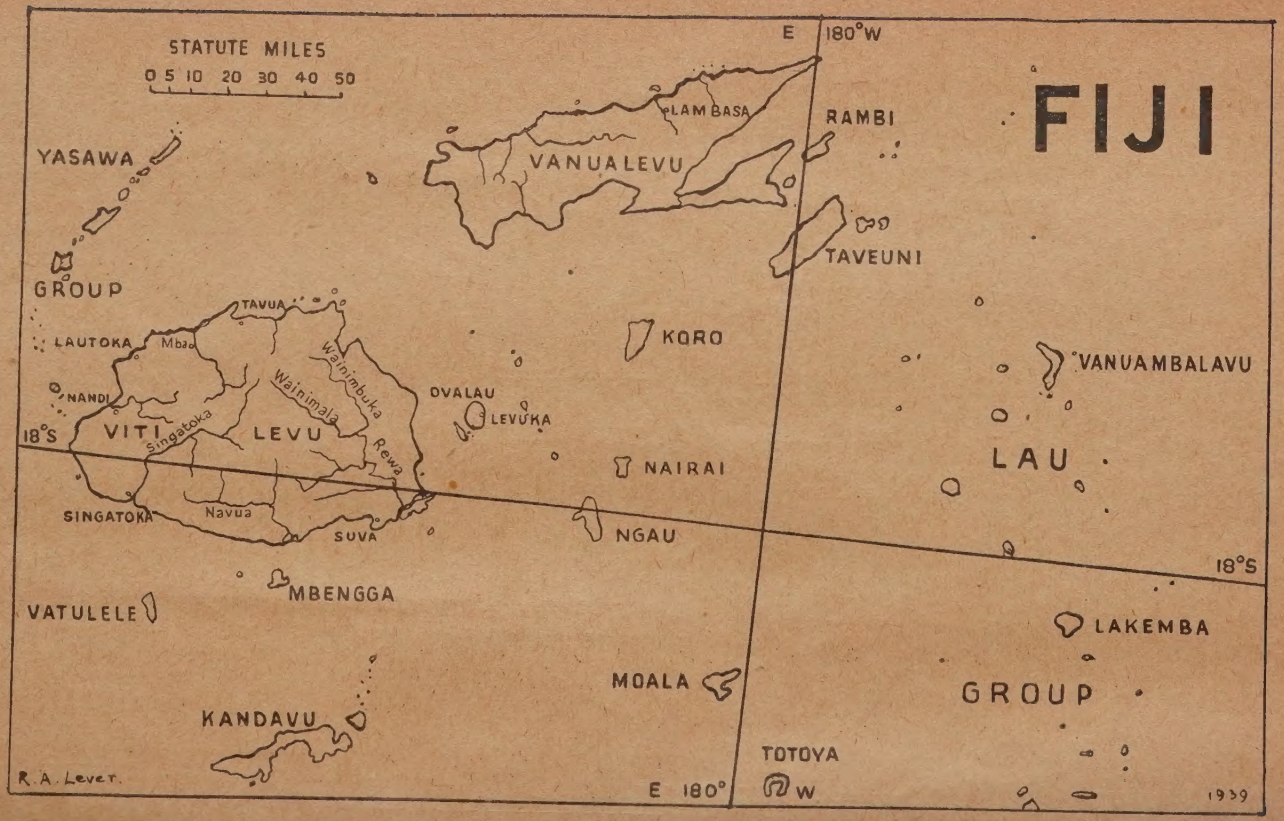
Page 41, last paragraph.—For " plant " read pest.

Page 54.—The article on " Protective Foods " was reviewed by Dr. Jack from *Nature*, Vol. 146, No. 3671, of March 9th, 1940.

Page 58.—The article entitled " The R. H. Phillips' Collection of Fijian Moths " was reprinted from the *Australian Magazine* for September 1938. The source appears as the final reference at the end of the article.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1939

AGRICULTURAL JOURNAL

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DEPARTMENT OF AGRICULTURE, FIJI.

VOL. 11.] SEPTEMBER, 1940. [No. 3.

EDITORIAL.

SINCE the last issue in June the local copra situation has become acute and drastic measures have had to be taken to reduce to an absolute minimum all expenditure on estates that normally employ labour. Many labourers have been discharged and production has been seriously reduced because the price of copra no longer provides sufficient funds to cover production costs on estates.

While exporters are still purchasing copra in limited quantities for storage in the hope of securing shipment, many producers find they cannot, at the moment, sell their copra and hence the general trade of the Colony is adversely affected since copra has always been a strong factor in the promotion of local circulation of goods and of money amongst both Europeans and natives.

The Government has given serious consideration to every aspect of the copra industry in consideration with local copra producers and exporters but, so far, under existing difficult shipping conditions, no solution to the problem has been found. Readers are well aware that the copra situation is not merely a local problem but, as pointed out in a recent Government communique, it is a world problem involving greatly restricted markets with a consequent heavy surplus of production in all copra-producing countries.

Amongst possible schemes of alleviation to the planters, Government has under consideration alternative uses for coconut oil; increased taxation on imported soaps and edible oils in order to increase local use of coconut products; the establishment of a Pacific pool by the various Governments concerned in the industry and the establishment of a local pig industry if an overseas market can be assured as an alternative occupation for planters.

A recent statement in the local press would indicate that some degree of assistance in marketing copra may materialise in supplying material for an oil and copra cake mill which is to be erected in Vancouver and it is hoped that this reported venture will soon become an accomplished fact. While no immediate solution of the problem appears possible, every consideration is being given to all practicable measures towards the elucidation of a serious and far-reaching problem which greatly effects the general prosperity of the Colony.

In this issue of the *Journal*, a progress report on citrus work carried out at Nasinu Experimental Station should prove interesting. The authors show that locally-grown citrus fruits compare favourably in general characters with citrus grown in other countries; that sweet orange stocks are less resistant to collar-rot than sour orange and rough lemon stocks and that further investigation of stock-action characteristics are desirable. The conclusions also show that budding and the distribution of budded plants should be expedited and this matter is receiving continuous attention within the limits of available expenditure.

A valuable article on the "Rearing of Calves" should prove a boon to stock keepers in providing solutions to the numerous problems confronting them. As a useful complement to this there is an abstract of Professor Woodman's article, which is continued from the last issue of this *Journal*.

The continued advance in the distribution of the green vegetable bug is mentioned with a record of the arrival of this pest on Vanua Levu. The very wide range of fruits and vegetables which this insect attacks makes its control much harder than other insects which have a more restricted selection of host-plants.

That bane of the wet season, the housefly, is dealt with in some detail by the Medical Officer of Health and it is hoped that this very timely article will stimulate all town and country people alike to see that breeding grounds are not provided for this loathsome insect to lay its eggs or complete its life-cycle.

It will probably only be a short time before Suva finds itself a civil air base and so liable to allow the entry of unwanted insects in aeroplanes if measures are not taken to control them as is done elsewhere. An interesting article on insects in aircraft shows what has been done on one American island on the route from Asia and what is contemplated on an even smaller island lying between Melanesia and Hawaii.

CARE AND FEEDING OF CALVES.

By
C. R. TURBET, B.V.Sc., M.R.C.V.S.,
Senior Veterinary Officer.

As is to be expected calves do best when raised by theirs dams. Their resistance to disease, increase in weight and general vitality is greater under such conditions providing the dam herself is receiving a suitable ration. This method of calf raising is however, applicable only when cattle are raised for beef purposes.

Colostrum and weaning.—There is some divergence of opinion as to the age on which a calf may be weaned. It is argued that if taken from the mother immediately at birth it will learn to drink from a bucket more rapidly. If this is done however, it is imperative that the calf should receive the first milk drawn from the mother, and only milk from the mother fed for the next 4 days. This is necessary because the first milk of the dam contains a substance known as colostrum. This substance is rich in vitamins and bodies which enable the calf to make normal growth and overcome disease. It also has a laxative affect on the bowels and causes the contents of the bowels at birth to be rapidly evacuated. If the milk of the mother is not fed the disease resistance is low and the calf is almost certain not to survive.

It is interesting to know that the quantity of vitamin "A" in colostrum is from 10 to 100 times higher than that of later milk. The quantity is greater in the first colostrum but falls rapidly to the fourth day.

Other authorities prefer that the calf should remain with the dam and suckle until it is about 4 days old. By this means the calf is certain to obtain the first milk or "beastings" as it is sometimes called. At the end of this period there is at times some difficulty in getting the cow used to being without her calf and in teaching the calf to drink, but these difficulties are soon overcome.

Good results may be obtained with either of these methods, but the farmer should decide which method he is going to adopt and stick to that method as a routine.

Feeding skim milk.—Where the production of butterfat is the principal aim, skim milk is usually available in abundance for calf feeding. Skim milk alone is however, too rich in regard to the proportion of protein to starch and fat which it contains. This is so because the fat has been removed by separation from the milk. Skim milk has in fact a nutritive ratio of about 1 is to 1·5, whereas whole milk has a nutritive ratio of 1 is to 4·4 which latter ration is ideal for the nutrition of young animals.

Calves reared on butterfat dairies should receive their own dams' milk for 4 days and whole milk until two weeks of age. In the next few weeks the whole milk should be gradually replaced by skimmed milk, supplemented by the addition of fat or oil, or by a concentrate rich in starch to replace the butterfat taken out. Linseed and other oils including coconut oil have been recommended for this purpose. Calves, however have a limited ability to digest free fat and the amount of oil added to skim should not at first exceed ½ oz. per quart of milk. If the calves gain a liking for coconut oil it may be added to their milk increasingly in small amounts to their milk up to 4 ounces per feed. It is better however, if the oil can be emulsified in the milk which has been warmed. This may be done by forceful mixing of the oil and the milk with a small pump of the garden spray type.

On the other hand maize meal finely ground provides a very good source of starch which acts as a fat substitute in the ration. Maize is usually available in Fiji but for feeding to calves it must be reduced to a meal. It is also very beneficial owing to its high vitamin content. Starting with small quantities for calves of about 2 weeks old the quantity may be gradually increased as the calf grows until maize meal forms about 30% of the total ration.

Quantity to feed.—The quantity of skimmed milk to be fed varies with the size of the young calf. Feed twice daily at the temperature at which the milk comes from the separator or better still at blood heat (101·6° F.). From 6 to 10 lb of milk should be allowed daily. Gradually increase the amount of skim milk fed up to a maximum of 18 lb daily at about 6 weeks. the largest amount fed should not exceed 2 gallons daily, given in two feeds.

Feeding whole milk and "calf starter."—In the case of calves bred on milk-producing dairies the farmer must obtain the greatest possible value from the sale of milk produced on his farm if he is to be successful. It is often found that calves on such dairy farms are insufficiently nourished and fail to develop into dairy cows of high productive ability. The total quantity of milk which can be spared for calf raising under these conditions is often insufficient, particularly when farmers attempt to raise too many calves annually. It is advisable therefore that the number of calves to be raised should be limited to a few from cows of known high productive ability.

The total amount of whole milk fed in raising any calf may be reduced to between 35 to 40 gallons, provided a suitable supplementary food is fed. It was formerly the practice to feed this supplementary ration in the form of a gruel. It has been found recently however, that better results are obtained when the supplementary food, which may be called "calf starter," is fed dry.

The method adopted at Cornell University is on the following lines:—During the first four days the calf is left with its mother. The daily allowance of whole milk in the successful 7 weeks of feeding were 8, 9, 10, 9, 7, 6,

and 4 lb, the milk being eliminated entirely in the 8th week. From 2 weeks of age until the average daily consumption reached 4 lb the dry "calf starter" was fed to the calves in as great a quantity as they could consume.

Owing to the impossibility of securing the feeding stuffs included in the Cornell ration it can not be given here. A substitute "calf starter" ration which can be made available in Fiji might consist of the following:—

Yellow maize meal	32 lb.
Pollard	30 lb.
Coconut meal	20 lb.
Hull free rice bran.	16 lb.
Sterilized bone meal	1 lb.
Salt	1 lb.

(Nutritive ratio = 1 : 5 : 5)

When the calf has reached 6 months of age reduce the pollard in the ration to 20% and add 10% of molasses.

Beginning at 2 weeks of age calves should be allowed free grazing on good pasture containing a mixture of grasses *i.e.*, the legume plants known as desmodium or tropical clovers, should be encouraged as much as possible in the grasses.

Rotation of grazing.—Where calves are raised in a single small enclosure the land is apt to become "calf sick" This means that the soil and pasture is affected both with eggs of interstinal worms and harmful bacteria. To avoid this a system of rotation of pasture should be followed. By this method also the nutritive qualities of the grasses are improved.

Water supply.—No swamp areas or surface water should be included in enclosures kept for calves. The reason for this is that such places become infected with the larvae of worm parasites. Infection with these parasites must be avoided. Clean water should be provided in wooden, iron or cement recepticles with the sides having a good clearance from the ground. The earth surrounding the drinking trough should be covered with cement or with a porous material such as gravel.

Calf shelter shed.—In long continued wet weather calves suffer much from exposure. To give the calves the best chance of surviving, a weather shed should be provided. Calves up to 2 weeks of age may be kept constantly under cover in a well-ventilated clean shed. After that they should be allowed access to a shed whenever wheather conditions make it necessary. To economise in building space, it may be convenient to include feeding equipment in the form of small bails in association with the weather shed. A suitable shed would be one having a well-drained cement floor or a floor consisting of slats through which droppings fall to the earth below. In the latter type the slats should be slightly rounded on top and placed sufficiently close together to prevent the calf from having its leg caught. The cement floored type is probably more convenient to build and manage. The shed should be provided with a roof and enclosed on one or two sides against the prevailing weather.

Cleanliness in feeding.—All buckets or other utensils used in feeding calves should be kept as clean as possible. The feed bucket is a common source of infection of the calf with the germ which causes white scours. It is able to survive in milk soiled buckets when these are not properly cleansed. Milk left in them to sour becomes a favourable medium for bacterial growth. The hands of attendants should be well washed with soap and water before teaching a calf to drink by the finger method.

Pervention of disease.—Calves are subject to disease caused by poor nutrition, bacterial infection and by worm parasitism. Infection may be prevented by correct feeding the adoption of clean methods in calf feeding and watering, the rotation of pasture, the feeding of colostrum and the maintenance of the resistance of the calf by protection against bad weather conditions.

Diarrhoea or "scours."—Scouring or diarrhoea is usually one of the first signs of illness in a calf. First aid treatment may be adopted by ceasing to feed milk for a day and the substitution of a thin flour gruel to which a pinch of salt has been added. The calf should also receive a dose of castor oil about 1 oz. or linseed oil 2 oz. This may be followed by doses of the following mixture fed with each meal for a few days:—Formalin, 1 oz.; water, 1 pt. Of this mixture give 1 dessert spoonful in each feed fed.

Control and treatment of worms.—In the control of intestinal worm, parasites pasture rotation and good drainage of these pastures are essential. In addition, actual medicinal treatment of the calves should be adopted. The mixture consists of:—

Bluestone	1 oz.
Nicotine sulphate 40 % solution ..	1 oz.
Water	2½ pints.

This mixture preferably be freshly made using an enamel or glass vessel for mixing, since the bluestone corrodes iron vessels. After starving the calves for 24 hours but allowing them water, they are drenched at a dose rate varing from 2 oz. for 2 months old calf to 5 oz. for a 10 months old calf. It is well to repeat the drench at monthly intervals. It is advisable to follow the drench in about ½ hour with a laxative dose of caster oil or linseed oil as before mentioned. Feeding may be allowed to the calf 2 hours after drenching.

Lung worms.—The presence of lung worms causes parastitic bronchitis. The mortality from the condition is high. The worms may be killed by injecting drugs into the wind pipe. A suitable mixture would be:—

Creosote	1 part.
Chloroform	1 ,,
Oil of turpentine	2 ,,
Olive oil	4 ,,

Dose: 8 c.c to 10 c.c.

The administration of the mixture requires some technical skill. It is done by injecting the mixture by means of a syringe through a hypodremic needle inserted between the rings of the wind pipe. It will be usually not possible for the farmer to administer this treatment. Very good control may be affected however, by rotation of pasture, provision of a pure water supply, maintaining the calves on a high plane of nutrition and by controlling stomach and intestinal worms as described above. By close attention to these matters the vitality of the calf may be maintained at such a high pitch that lung worm infection is thrown off.

THE HOUSE-FLY, PUBLIC ENEMY NO. 1.

By Dr. G. R. Baxter, M.D., B.Ch.D., D.P.H., D.T.M. & H., Medical Officer of Health.

FLIES are usually looked upon merely as irritating nuisances. They annoy by their buzzing; because they fall into your cup of tea or coffee, or into your glass of beer; because they persistently return to the jam dish or toast rack even when repeatedly swished away; by their irritating crawling over bald heads and bare backs. They are, of course, much more than nuisances and disturbers of the afternoon nap, being dangerous carriers of disease and everyone should know something of the life history of these objectionable pests.

There is nothing mysterious about flies any more than there is about mosquitoes. There habits and haunts are well known and, as with all insect pests, eradication of their breeding places will control their prevalence. In short, " No breeding places—No flies " should be the slogan for all anti-fly campaigns.

What kinds of flies are prevalent in Fiji and how can we recognise them, and what can we do to keep them in check ?

Firstly, there is the ordinary " house fly " *Musca domestica* or closely allied species. These flies are found in practically all parts of the world. They are medium in size, greyish in colour with dark stripes down the back. They are quick in movement, attracted by human food, persistently returning to the same spot even when chased away, they buzz slightly, but not the fussy buzz of the familiar " blue bottle." By reason of their attention to human food these are the particularly dangerous variety—the pests of the kitchen and the dining table. It is interesting to note, and an important fact, that insects in general do not grow—*i.e.*, a small fly never grows into a bigger one; once hatched out they remain the same size. Maggots, of course, do grow and a well-fed, fat maggot will produce a bigger, better fly than a half starved maggot deprived of its food-supply. It is interesting to observe that house flies do not usually settle on butter, as they do on most other kinds of food, as their feeding habits do not permit them to deal with food insoluble in their saliva. These flies do not, of course, bite in the true sense of the word like mosquitoes or stable flies.

There are also the familiar " blue bottles " or blow flies buzzing round where there is decaying flesh or dead fowls, &c., and seeking to deposit their eggs on meat. These are the flies of the slaughter houses and butchers' shops and fish markets, and their larvæ are true scavengers. The red " heads " can easily be distinguished and they are scientifically called *Calliphora erythrocephala*, which simply means the " red-headed blue bottles." Closely allied are other " blue bottles " and the " green bottles " seen at rural slaughter places, especially where the offal is buried, but for practical purposes they can all be treated as " blue bottles."

They are attracted by discharging sores and ulcers of man or animals and many diseases may be carried because of these habits.

We must not miss the genuine stable fly *Stomoxys* with a real hefty proboscis, which can be seen in front of the head and can inflict a stab like a needle. It is a true blood sucking fly and closely allied to the dread Tsetse fly of Africa—which carries sleeping sickness. It closely resembles a large house fly save for its " battle arrangement " in front.

There are, of course, many others, but it should be sufficient to say, that the following can be recognised by ordinary people. The ordinary house fly, persistent and liking human food. The smaller house fly, clustering

and soiling ceilings and lamp shades, &c. The fat, lethargic house fly, easy to swat and squashy. The blue bottles fussing and buzzing around after meat. The stable fly, associated with cattle and a real hefty biter.

The following are the facts in the life history of the house fly. Flies may live for many weeks in the climate of Fiji. The females can lay eggs in less than a fortnight after hatching. The number of eggs laid at one time is about 100, and a fly can deposit at least five or six batches in a lifetime.

The eggs are white and like very small grains of polished rice. They can easily be found by anyone. Eggs are laid only in material that will provide food for the future maggots. This is most important, for it means that eggs are only laid in moist and usually warm material. The ideal medium is in manure of all kinds, and in Fiji it has definitely been proved that cow dung is a prolific source of fly breeding.

The eggs develop very quickly into larvae or maggots. At first they are white and small having a narrow end which is the head, the rear portion being blunt.

The maggots very soon burrow into the material out of sight. This is an extremely important fact in Fiji, for the larvae are than inaccessible to some of their natural enemies.

The maggots feed and grow and moult and then after about a week is another important fact in the matter of controlling flies—known as the migration of the larvae. The grubs leave the moist matter and seek a dry spot in the earth in which they can develop into a pupa or chrysalis and pass their wonderful transformation from a crawling worm into a winged insect. This outwardly, is a resting stage, the maggot has shrunk in length and become short and barrel-shaped and dark brown, something like a large seed. This knowledge of the migration to find a place to pupate, a place away from the haunts of the maggot stage, enables us to devise useful methods for dealing with stable manure, and so prevent a good deal of fly breeding. The principal is to trap the larvae during the "migration period" and it is often very successful in dealing with stable manure –accumulations outside cow bails, &c.

The pupal stage lasts about a week and finally the fly is hatched. The fly escapes from the pupa case, and in the case of buried pupae the insect can make its way through loose soil, by means of a ram-rod or automatic mallet arrangement in front of the head. They have been known to make their way through about two feet of soil in this manner. Within an hour or so the fly has "hardened" and the wings have become capable of flight.

The whole body of the fly makes it perfectly suited for carrying filthy matter from place to place. The body itself is hairy, the legs are hairy and they have sticky pads on the feet to enable the flies to walk upside down. These pads also collect filth.

Flies have dirty feeding habits—having to liquefy food by their "saliva" before they can take any. They soil food by their droppings—and indeed frequently come directly on to human food from most undesirable places.

The distance a fly can travel by air from the breeding place is extremely important and experts vary very considerably on the question. They have been traced over long distances in favourable conditions. For all practical purposes where houses are numerous (in towns) flies may infest an area about a quarter of a mile in radius from an obvious breeding place. In rural districts where grazing land is extensively used and where buildings are much more scattered and where breeding grounds are more extensive and concealed, much larger areas may be infested by quite a few scattered breeding grounds.

The fly problem is fairly easily dealt with in closely settled areas. In rural districts the problem is entirely different.

We must not forget that in rural districts there are stables and there are extensive cattle grazing areas with cow bails, that pit latrines are often open and exposed, with contents within a few feet of the surface. We must not forget that rural areas have no garbage service, and that over the garden fence or twenty yards in the bush on the outskirts of the village may be conveniently out of sight, and out of mind. Pigs are often kept, and fowls and ducks wander about near the dwellings.

We must not be too keen on laying the blame on adjacent cattle if our own garbage disposal or latrine is defective or if the fowl yard or duck pen is badly kept. Again a personal weekly walk round the garden or compound is really necessary to see that orders are being carried out properly, and that rubbish and garbage is being disposed of in a suitable manner, and not just dumped anyhow, and to see that rotting fruit is not left lying under the trees &c.

I must confess that the disposal of rubbish in a rural community is by no means an easy matter, especially in a wet climate, but flies will never be controlled unless very close attention is given to this problem.

The diseases mainly carried by flies are dysentery, typhoid and infantile diarrhoea. Many worm conditions and even tuberculosis may be carried by flies. Sore eyes and conditions like yaws and small-pox are frequently spread by these filthy creatures.

In short, the more you think about flies, the more disgusting do they become, and it becomes very evident that the only good fly is a "dead" one. The common sight often seen in native villages of the family seated on the floor of the hut, eating food whilst the mother complacently fans off swarms of flies from the babies and dishes of food, is revolting in the extreme.

School children should leave school with a real knowledge of the life history of the fly and where it breeds and be instilled with a horror of its filthy habits, and should know simple methods of dealing with breeding places.

How we can safeguard ourselves against the fly peril and apply preventive measures, will be dealt with in another article. In the meantime this home truth must be pressed home. Where there is undue prevalence of flies, there is filth of some sort and quite near—either manure, garbage, rotten fruit, dead birds or something of this nature—and a good look round will find the breeding ground. The important principle in dealing with all insect pests must be stressed, the breeding places must be attacked and not the individuals.

This apparently applies to all kinds of warfare whether against disease, insect pests, or vermin of any kind.

MEASURES AGAINST ADULT FLIES.

As flies cannot be prevented from breeding altogether, the following measures are described for use against the adult flies.

(*a*) *Screening.*

The whole dwelling, or at any rate the kitchen and dining-room, can be made fly-proof by use of screens of wire gauze fitted over all openings and kept in good repair (sixteen-mesh wire is best for this purpose). Wire doors should always open outwards. In practice, the screening is seldom done efficiently and this measure is only auxiliary to others.

Screening of food is a highly desirable and hygienic practice and is extremely necessary in camps. Screens may take the form of safes or simply covers of cloth or wire placed over containers. This does not prevent the annoyance of flies at meal times, however, and the following measures may also be used.

(*b*) *Fly Sprays.*

These are very effective in an enclosed space or where flies congregate in large numbers. In the first case, the room or tent should be closed and filled with a fine mist or spray by means of an atomizer and left for half an hour. Out of doors it is necessary to spray directly on the flies. The spray commonly used is made up as follows:—

Pyrethrum	½ lb
Kerosene	1 gallon
Methyl salicylate	3 fl. oz.

Shake occasionally over a period of two hours and strain off the liquid. The methyl salicylate can be omitted, as it is present merely to impart a pleasant odour. This is also excellent for mosquitoes. A similar recipe is:—

Soap	¼ lb
Water	½ gallon
Kerosene	1 gallon

(*c*) *Fly Traps.*

Where flies are very numerous traps undoubtedly can do a lot to reduce the fly population. The simpler they are the better and most of them depend for their success on the habit of flies of going upwards and to the light after leaving food. This habit of seeking the light is important, especially for traps for pit latrines or offal disposal pits at rural slaughter-houses.

The trap usually consists of a small opening at the top of a cone of wire gauze. The flies can just pass through into the collecting chamber. A narrow slit can be similarly used. Traps are useful in kitchens—especially for camps, native restaurants, &c. A cheap form is the "Kande" trap neat and handy and very efficient—a small "globe" of wire gauze with tray for bait at the bottom with the cone entrance over it. It costs less than 2 shillings.

Larger traps can quite easily be constructed out of a kerosene box and a little wire gauze with a bit of ingenuity. The bottom portion should be dark, the metal gauze top should be open to the light.

Mechanical fly-traps, usually of Japanese construction, are sometimes seen and are very efficient but perhaps they are too elaborate and costly for ordinary use.

Points to remember are:—Traps should be placed where they are sheltered from strong winds or excessive heat and as near as possible to breeding places or points where flies are known to congregate. The smaller traps should be baited with sugar, jam, or perhaps treacle mixed with beer. For the larger traps—for larger institutions, chicken entrails, or fish gills are suitable—but these are too smelly for small domestic kitchens.

Baits should be renewed regularly and the traps emptied regularly. Boiling water will kill the flies, and they can be destroyed by fire or heat.

(*d*) *Poison Baits, Fly Papers, Fly Swats, &c.*

A safe and effective poison bait consists of three teaspoonfuls of commercial formalin to one pint of milk or water with a little sugar added. This can be put out in saucers containing blotting paper, or bread may be soaked in the solution.

Fly papers and fly wires are prepared by use of the following mixture:—

Resin .. .. 2 lb
Castor oil .. .. .. 1 pint

Heat together to treacly consistency. (The proportions may need modifying in hot climates). Smear on paper or wire. The wire can be used again and again by cleaning it in a flame and renewing the adhesive, and this device is often very useful in large kitchens in camps, institutions, &c.

Fly swats are very useful in disposing of flies which may have found their way into a proofed kitchen, &c., for there is nearly always the odd, one, strangely persistent fly, just when, and where, you least want it.

Two slogans complete this article, they are:—

"Where there are flies, there is filth."
"No breeding places, no flies."

(To be concluded.)

OBSERVATIONS ON CITRUS INTRODUCTIONS AT NASINU.

By
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An increasing local demand for budded citrus seedlings recently necessitated a survey of the work done and the methods adopted at the Nasinu Experiment Station during the past few years, so that new avenues could be explored and alternative methods adopted to increase the output of better material.

An examination of the past nursery work indicates that difficulty was experienced in raising thrifty stocks, that a low percentage of bud "takes" was obtained and that the development of evenly distributed scaffolds of 4 or 5 branches was also difficult to obtain. Nursery work with various kinds of stocks is proceeding according to programme and within a few months large numbers will be ready for budding. The planning of budding operations automatically raised the question as to which varieties should be used and as no detailed information was available it was decided to undertake at Nasinu a systematic examination of the existing established collection in order to reveal the most promising varieties and stocks, or at least to indicate the obvious discards which should not be propagated.

This paper is, therefore, compiled from information resulting from an examination at Nasinu of established varieties and stocks and is part of an investigational programme embracing citrus culture in the wet zone of Fiji.

HISTORY AND DETAILS OF ESTABLISHMENTS.

The history of the citrus collection is that of the Nasinu Experiment Station. The Station was originally opened in 1905 and citrus was established in 1906 and 1907. This early establishment consisted of sixteen orange and two mandarin varieties, Lisbon lemons, shaddocks and limes. Two grape-fruit varieties—Triumph and Marsh Seedless—were imported in 1913. Two varieties of seedless limes were also imported about this time. Early reports of the Department are disjointed—each annual report includes a paragraph on citrus but essential details are omitted. These

plantings consisted of budded and seedling stocks but no information is available regarding the type of stock used or the countries of origin of the varieties. The importance of the stock in those days was not appreciated. Reports indicate that the orange varieties "Paramatta" and "Valencia Late" were the most promising, and that a trial shipment of fruit to Australia in 1916 showed that the varieties Washington Navel and Paramatta carried best. In 1922 the Station was closed on grounds of economy and no further records are available on the early establishment. At the present time scattered trees in poor condition are evident; these embrace Paramatta and Nasinu oranges, seedless lime and one seeded variety and one or two unpalatable grape-fruit trees. The Nasinu orange is probably a survivor of the early planting and renamed Nasinu in later years. The orange varieties were examined, but the grape-fruit varieties were discarded owing to their obvious bitter flavour.

In 1930 the Station was partially re-opened. In 1931 the following citrus varieties were imported from Trinidad, B.W.I. and established in the field:—Duncan Grape-fruit, Jaffa Orange, Valencia Late Orange, Marsh Grape-fruit, Parson Brown Orange and Washington Navel.

All these varieties are reputed to be budded on sour orange stocks. Approximately about the same time two orange varieties, Valencia Late and Mediterranean Sweet, on local sour orange and rough lemon stocks, and one grape-fruit—Tommy Horne—on Fiji sweet orange stock were established in the same area.

Subsequent plantings, listed as follows, were locally budded and established in the field in 1934 35. (Two grape-fruit varieties –Krome Davis, and Marsh's Seedless—on unknown stocks—were imported from Jamaica and established in 1934).

Duncan grape-fruit	on Fiji sweet orange.
Marsh grape-fruit	,,
Marsh grape-fruit	on Fiji sour orange.
Parson Brown orange	on Fiji sweet orange.
Valencia late orange	,,
Washington Navel orange	,,
Mediterranean sweet orange	,,
Paramatta orange	,,
Nasinu orange	,,
Nasinu orange	on Fiji sour orange.
Seedless lime	on Fiji sweet stock.

Until 1922, the trees received periodic weedings and several successive crops of cow-peas were planted and dug in as green manure.

The treatment of 1931 plantings is vague and no information is available until 1935, from which date the area was penned with poultry, cutlassed at regular intervals and the trees were ring-forked periodically.

CLIMATIC AND SOIL CONDITIONS.

The climatic conditions operating at Nasinu are typical of the wet zone of Vitilevu and are summarised in the following table.

Nasinu Station.—14 years.

Month	Temperature.		Moisture (100=Saturation).	Barometer at 32°F. and M.S.L.	Rainfall.	No. of days of rain.
	Maximum	Minimum.				
	°F.	°F.		"	"	
January ..	85·1	72·4	80·3	29·865	11·56	23·6
February ..	85·7	72·3	81·2	29·818	12·57	22·0
March ..	85·6	72·3	83·8	29·893	16·13	24·5
April ..	84·0	70·9	83·0	29·942	11·33	23·5
May ..	81·4	69·2	84·4	30·011	12·75	22·5
June ..	79·7	66·8	84·0	30·036	7·99	18·3
July ..	79·2	64·8	83·1	30·055	6·54	18·2
August ..	78·6	65·4	81·4	30·053	7·43	17·9
September ..	79·3	67·2	80·2	30·050	8·00	21·4
October ..	80·9	67·4	78·0	30·029	8·85	18·3
November ..	82·6	69·8	78·2	29·961	12·15	20·3
December ..	84·8	71·3	78·8	29·888	14·10	22·8
Means ..	82·24	69·15	81·37	29·966	...	..
Totals ..	..	..	..	..	129·40	253·3

As will be seen, the average rainfall for 14 years is about 130 inches and the precipitation is distributed over some 253 days annually. The temperatures from October to April vary little from the mean of 82°F. and in the cooler months of May to September the average figure approaches 69°F. Humidity is high all the year round and the maturation of citrus fruits is frequently adversely affected by the incidence of rains in the harvest season.

The soils of Nasinu are immature and have been developed by the impress of climatic data recorded above on a parent material known locally as soapstone. The soapstones of Fiji are marine consolidated volcanic ash and muds containing much calcareous matter of marine origin and varying widely in composition. The Nasinu variety of soapstone is rather more siliceous than normal.

From an agricultural standpoint, the soils of Nasinu can be classed as heavy clays with little organic matter, phosphate and potash, the availability of potash and phosphate being extremely low. The exchangeable base and exchangaable calcium as m.e./100 grams of soil are extremely low.

From the scientific standpoint the soils may be classified as structureless lateric clays with an immaturely developed profile. Small ironstone nodules are separated in the mechanical analysis and the composition of this material is recorded in the following tables.

TABLE 1A.

Determination.	A per cent.	B per cent.
Fe_2O_3	7·54	44·46
Al_2O_3	16·49	22·01
CaO	12·77	0·56
MgO	5·78	0·20
K_2O	1·64	..
Na_2O	2·72	..
NiO	trace	..
SiO_2	38·56	8·49
P_2O_5	trace	0·26
$H_2O + CO_2$ ..	14·32	21·56
Mn_3O_4	..	3·60

A = Composition of parent material Nasinu soils.
B = Composition of ironstone nodules Nasinu soils.

TABLE 1B.

Profile Characteristics.

Determination per cent	1st. ft.	2nd. ft.	3rd. ft.	4th. ft.
Coarse sand	14·27	2·95	1·49	4·78
Fine sand	11·18	15·67	7·63	14·65
Silt	16·08	26·02	29·00	24·96
Clay	47·43	45·74	49·75	45·15
Moisture	9·68	7·93	11·09	9·25
$CaCo_3$	..	..	..	..
Organic matter, &c., dissolved in pretreatment	1·36	1·69	0·04	1·21
Ph	5·2	5·4	5·4	5·4
Ex. bases m.e./%	2·53	..	..	..
Ex. calcium m.e./%	0·48	..	..	..
Nitrogen	0·19	..	..	..
Acid soluble P_2O_5	0·08	..	..	..
1% citric soluble P_2O_5	0·003	0·001	0·003	0·002
Acid soluble K_2O	0·14	..	..	..
1% citric soluble K_2O	0·009	0·009	0·002	0·002

Seedlings once established on these soils appear to grow well provided there is adequate drainage, nevertheless it is suggested that the soils require organic matter, lime and phosphatic fertilization.

FIELD OBSERVATIONS.

The 1907 plantings were disregarded owing to the lack of information of varieties and stocks, but samples of fruit from the known varieties Paramatta and Nasinu were analysed for fruit quality for purposes of comparison with fruit from younger trees.

(*a*) GRAPE-FRUIT.

(i) *Tree description.*—All the grape-fruit varieties in the three age-classes exhibit robust, healthy growth and compare favourably with trees in other countries. The old trees of the 1907 plantings remain healthy and prolific. The varieties imported from Trinidad in 1931 are excellent specimens and bore a splended crop this year. The trees of the 1935 class show excellent promise and the majority carried a small crop. Table 2 shows a comparison of development of the three age classes.

TABLE 2.

Variety.	Stock.	Date of planting.	Mean height.	Mean spread.
			feet.	feet.
Duncan	Sour orange	1931	13	17
Marsh	,,	,,	13	17
T. Horne	Sweet orange	,,	14	17
K. Davis	Unknown	1934	7	8
Marsh	,,	,,	6	5
Marsh	Sweet orange	1935	10	9
Marsh	Sour orange	,,	9	8
Duncan	Sweet orange	,,	10	9

It is not intended to compare the performance of the varieties and the effect of the stock or robustness, but the figures are submitted to indicate tree size of the two age groups. It can be concluded that the combination of the above varieties and their respective stocks is satisfactory for tree development.

It would be unwise to draw conclusions of the stock effect or scion robustness as the trees were planted in continuous rows and it is not possible to assess soil fertility trends. The figures, however, do indicate a slight preference for the sweet orange stock, but the differences in both age groups are small and from a practical yield aspect, are insignificant.

(ii) *Yield of fruit.*—Records of yield of individual trees have not been maintained, therefore it is impossible to draw any conclusions regarding yield.

This year all trees carried exceedingly heavy crops and the general indications are that fruit production of all the varieties on both stocks is satisfactory. The performance of the young trees of the 1935 age class can also be considered satisfactory on the performance of this year—five years after planting.

(iii) *Description of fruit.*—The Duncan grape-fruit of the 1931 planting is of good appearance and develops an attractive colour if allowed to ripen on the tree or if picked under-ripe and stored for a week or more. The size is variable but the majority are of marketable size.

The Marsh grape-fruit of the same planting is also of good appearance and colours well on ripening. The size of fruit is more variable than Duncan owing to a higher percentage of very large fruits.

"Tommy Horne" is a smaller type of fruit and more uniform in size. This variety also colours well on ripening. It is probably Marsh, the present name being derived from the owner of a local plantation.

The varieties K. Davis and Marsh, planted in 1934, produced uniform fruit of medium size. Both are attractive fruit and colour well on ripening.

The fruit from the younger trees—1935 planting—is more variable in size and does not develop so well as the older trees.

(iv) *Incidence of collar-rot.*—During the examination of individual trees it was observed that collar-rot was prevalent and that a detailed examination was necessary to ascertain its distribution amongst the stock types. Table 3 indicates the incidence and the percentage infection.

TABLE 3.

Variety.	Stock.	Date of planting.	Collar-rot infection.
Duncan	Sour orange	1931	..
Marsh	„	„	..
T. Horne	Sweet orange	„	33
K. Davis	Unknown	1934	..
Marsh	„	„	..
Marsh	Sweet orange	1935	30
Marsh	„	„	4
Duncan	„	„	35

These figures are submitted to indicate that the sour orange stock is very resistant and that sweet orange stock is very susceptible to collar-rot. It should, however, be stated that in the examination it was observed that

severe knife damage, probably during cutlassing, was evident and that owing to low budding, the bud union was at ground level. These conditions combined with poor soil drainage and heavy rainfall are conducive to collar-rot and it is probable that with improved methods the incidence could be reduced.

(v) *Incidence of minor diseases and insect pests.*—Various fungi and scale insects were evident attacking fruit, leaves and branches. The fruit when severely attacked becomes discoloured and unattractive. The incidence of these minor pests is not unimportant, but with improved field sanitation and the use of sprays, they could be controlled and reduced to insignificant proportions.

(vi) *Quality of fruit.*—In assessing quality, six to twelve fruits from each variety, chosen at random, were examined. The fruits were picked when it was considered that they had reached a stage leading to maturation under normal storage conditions. It is admitted that the number of fruits chosen for examination was small and that more reliable data, designed to eliminate variation in individual fruits and trees as far as possible could only be obtained by an examination of a much greater number of fruits in a properly designed experiment. Hence, no attempt has been made to test for significance. In some varieties three pickings were possible during the season, in others two and in some orange varieties only one picking was possible.

Data were collected concerning individual physical and chemical characteristics, which are summarised in Tables 4 and 5. The acidity, reported in terms of citric acid, was determined by direct titration with N/10 sodium hydroxide, while total sugars, calculated as invert sugar, were determined by the Lane and Eynon method after inversion of the juice with hydrochloric acid. The specific gravity of the juice was determined in a specific gravity bottle at 20°C. and the total solids calculated from the formula $C=\frac{1,000\ (D-1\cdot000)}{3\cdot85}$ adopted by South African workers., where C=concentration of soluble solids per 100 ccs. and D=density of juice at 20°C.

TABLE 4.

Average Physical Characteristics for the Season.

Lot No.	Weight.	Max. wt.	Min. wt.	% skin.	% juice.	% rag.	Skin thickness in cms.	Name of stock.
	grms.							
7	309	454·5	196·4	33·4	39·8	26·8	0·77	Krome Davis—Unknown Jamaica.
8	303	403·2	261·4	26·3	38·6	35·1	0·73	T. Horne—Fiji sweet orange.
9	477	558·5	403·3	26·0	42·7	31·3	0·87	Duncan sweet orange—Trinidad.
10	426	602·0	255·0	28·0	42·3	29·7	0·82	Marsh sour orange—Trinidad.
11	324	402·5	241·2	33·6	34·0	32·4	0·91	Marsh—Fiji bitter orange.
14	389	468·0	354·0	28·7	42·8	28·5	0·85	Duncan—Fiji sweet orange.
15	380	486·5	363·0	31·2	40·3	28·5	0·76	Marsh—Unknown—Jamaica.
16	407	516·3	302·3	30·6	42·6	26·8	1·02	Marsh—Fiji sweet orange.

TABLE 5.

Average Chemical Characteristics for the Season.

Lot No.	Acidity as invert.	Total sugars	Total solids.	Ratio—acids: solids.	
				Average.	Minimum.
7	1·11	6·10	8·4	8·1	7·0
8	1·36	6·30	8·7	6·4	6·0
9	1·23	6·82	9·9	8·2	7·6
10	·97	6·45	8·9	9·2	8·1
11	1·14	5·70	7·9	6·8	6·5
14	1·11	6·15	8·5	7·7	6·9
15	1·14	5·79	7·9	7·1	6·4
16	1·24	5·22	7·3	6·2	6·1

Table 4 shows that the weights of individual fruits are good. There was, however, marked individual variation in some varieties. On the whole the appearance of the grape-fruit is excellent and in striking contrast to many of the orange varieties. There is a general tendency for a decrease in average weight with advancing season, such decreases being more marked in certain species. The heaviest and most uniform fruit are contained in Lot 9 —Duncan on sweet orange, Trinidad, but there is little to pick and choose between the varieties on the score of weight which is much more uniform that with the orange varieties.

"Tommy Horne" on Fiji sweet orange stock, Krome Davis on unknown (Jamaica) and Marsh on unknown (Jamaica) have thinner skins than the Duncan and Marsh on Fiji sweet orange. There is, however, some variation within varieties and with the possible exception of Marsh on Fiji sweet orange local budding, which retains a thicker skin throughout the season, there is little to pick and choose between varieties.

Under the conditions of the examination, as shown in Table 5 there is a tendency for grape-fruit varieties to conform roughly to 30 per cent. of skin, 40 per cent. of juice and 30 per cent. of "rag." The seasonal averages recorded for varieties shows considerable uniformity, the Duncans being a little better than other varieties. The slight differences, however, are by no means significant.

There is a tendency towards a decrease of approximately 8 to 12 per cent. in total soluble solids with advancing season. The variety yielding the greatest amount of soluble solids appears to be Lot 9—Duncan on sweet orange, Trinidad, and this fruit appears to maintain greater uniformity throughout the season. However, with the possible exception of the Duncan referred to, differences in total soluble solids are insufficient for use as a factor in selection.

There is a slight falling off in acidity during the season but, in general, acidities are comparable throughout, the greatest fall being observable in Lot 10, Marsh on sour orange, Trinidad.

The sugars follow closely the changes in total soluble solids and, in general, the data present a picture of uniformity with little varietal difference. The Duncans possess good sugar values and the choice would be slightly in that direction.

The average and minimum figures for the ratio of acid to soluble solids for the season are recorded in Table 5 and as a preliminary working basis it is suggested that the minimum figures for the ratio be adopted as standards of maturity.

(*b*) ORANGES.

(i) *Tree descriptions.*—Unlike the grape-fruit varieties, the orange varieties do not all present robust and healthy appearance. Some have done well, while others are failures. Table 6 shows a comparison of the development of the age classes and varieties.

TABLE 6.

Variety.	Stock.	Date of planting.	Mean height.	Mean spread.
			feet.	feet.
Jaffa	Sour orange	1931	10	6
Parson Brown	,,	,,	8	5
Valencia Late	,,	,,	6	5
Washington Navel	,,	,,	6	6
Valancia Late	Sweet orange	1933	14	14
Mediterranean Sweet	Rough lemon	,,	13	16
Parson Brown	Sweet orange	1935	5	3
Valencia Late	,,	,,	10	7
Washington Navel	,,	,,	9	8
Mediterranean Sweet	,,	,,	5	3
Paramatta	,,	,,	9	4
Nasinu Orange	,,	,,	8	5
Paramatta	Unknown	1909	?	?
Nasinu	,,	,,	?	?

All the trees in the 1931 age class are complete failures and not a single healthy specimen is now available. The general appearance of the trees suggests stock incompatibility as the adjacent rows of Valencia Late on sweet orange are robust and healthy. Furthermore, two replacements on sweet orange stock in the Valencia Late and Washington Naval lines make a marked contrast, in that they are robust and healthy. These replacements planted in 1935, four years afterwards, measure 7 ft. 4 in. and 7 ft. 9 in. respectively as compared with the mean of 6 ft. 5 in. and 6 ft. 6 in. for the original plantings. The 1935 establishment of the same varieties on sweet orange stock give no indication of stock incompatibility.

The 1933 age class are all robust and healthy trees. The third lot—1935 are most variable, but this variation is attributed entirely to variable soil and drainage conditions and to immaturity.

(ii) *Yield of fruit.*—No yield records are available, but the productivity may be assessed by this year's performance. The 1931 plantings are incapable of bearing heavy crops owing to their limited fruiting surface, while the 1933 establishment carried an excellent crop and the early crops of the 1935 plantings are most promising. The ability of 1933 and 1935 plantings to bear satisfactory crops on the enumerated stocks, under wet conditions seems assured.

(iii) *Description of fruit.*—With the exception of the fruit from the trees of the 1931 planting, all fruits are of good size and attractive in appearance. All colour well on ripening if allowed to remain on the trees, or if picked on the immature side and allowed to ripen in store. The fruit from the 1931 age class is small and of no commercial value.

(iv) *Incidence of collar-rot.*—The following table indicates the incidence of collar-rot in the collection.

TABLE 7.

Variety.	Stock.	Date of planting.	Collar-rot.
			%
Jaffa	Sour orange	1931	..
Parson Brown	,,	,,	..
Valencia Late	,,	,,	..
Washington Navel	,,	,,	..
Valencia Late	Sweet orange	1933	22
Mediterranean Sweet	Rough lemon	,,	..
Parson Brown	Sweet orange	1935	15
Valencia Late	,,	,,	24
Washington Navel	,,	,,	9
Mediterranean Sweet	,,	,,	..
Paramatta	,,	,,	3
Nasinu	,,	,,	2
Paramatta	Unknown	1909	..
Nasinu Orange	,,	,,	..

The figures, like those in Table 3, indicate that sour orange is more resistant to collar-rot than sweet orange stock. The two oldest age-classes form a good comparison in that the disease was only evident on sweet orange stocks. The comparison in the 1935 planting is difficult as the area is most uneven and excessive water logging occurs amongst some varieties. There is, however, sufficient evidence to indicate the susceptibility of sweet orange stock to collar-rot. With regard to the incidence of minor diseases and pests, the remarks made concerning grape-fruit apply equally to oranges.

(v) *Quality of fruit.*—The quality of the various fruit samples is depicted in Tables 8 and 9.

Table 8 indicates that the control orange (random sample of local commercial orange) is the heaviest and most uniform fruit and in general, it may be said that, with the exception of lot 12 (Parson Brown on sour orange stock) all the varieties examined produce good commercial fruit.

The skin thickness appears to vary little between varieties.

From the commercial view point, low "rag" and low skin with high juice percentages are desirable features. As shown in Table 9 the tendency in all varieties is for 20 per cent. of skin, 50 per cent. of juice and 30 per cent. of "rag" under the conditions at the Experimental Station. The lowest seasonal average for juice percentage is recorded for Washington Navel (42·5 per cent.) and the highest, Nasinu on Fiji Sweet Orange (53·5 per cent.). The Washington Navel (211 grms.) and the Control (261 grms.) score in the matter of greater fruit weight.

TABLE 8.

Average Physical Characteristics for the Season.

Lot No.	Weight.	Max. wt.	Min. wt.	% skin.	% juice.	% rag.	Skin thickness in cms.	Name and stock.
	grms.							
1	179	272·0	95·8	20·4	47·5	32·1	0·37	Jaffa sour orange—Trinidad.
2	188	217·6	161·4	19·4	49·0	31·6	0·31	Valencia Late—Fiji sweet orange.
3	185	255·6	167·0	19·9	47·5	32·6	0·36	Nasinu—Unknown.
4	211	305·2	148·0	21·6	42·5	36·9	0·40	Washington Navel Fiji sweet orange.
5	190	276·5	132·0	20·4	50·3	29·3	0·31	Mediterranean sweet—Rough lemon.
6	142	173·1	116·8	19·5	47·5	33·0	0·36	Paramatta—Unknown.
12	70	109·0	41·5	23·3	43·7	33·0	0·34	Parson Brown sour orange—Trinidad.
13	179	230·0	130·5	17·6	52·1	30·3	0·30	Valencia Late—Fiji sweet orange.
17	110	171·6	78·3	21·9	45·1	33·0	0·28	Valencia Late sour orange—Trinidad.
18	199	219·7	187·7	17·1	49·6	33·3	0·37	Paramatta—Fiji sweet orange.
19	195	225·5	155·2	17·6	53·5	28·9	0·38	Nasinu—Fiji sweet orange.
20	156	179·5	135·0	22·5	49·2	28·3	0·32	Parson Brown—Fiji sweet orange.
Control	261	288·0	235·0	15·8	48·6	35·6	0·31	.....

TABLE 9.

Average Chemical Characters for the Season.

Lot No.	Acidity	Total sugars.	Total solids.	Ratio—solid : acids.		Variety.
				Average.	Minimum.	
1	1·26	7·43	10·79	9·8	7·3	Jaffa.
2	1·49	6·88	10·14	6·9	6·2	Valencia Late.
3	1·76	6·99	10·93	6·2	5·7	Nasinu.
4	1·00	6·38	9·27	10·1	7·7	Washington Navel.
5	1·25	6·67	9·63	7·8	6·9	Mediterranean sweet.
6	1·69	8·42	11·67	7·2	5·7	Paramatta.
12	·82	8·05	10·60	13·3	11·4	Parson Brown.
13	1·19	7·59	10·19	8·7	7·3	Valencia Late.
17	2·02	7·06	10·27	5·1	4·8	Valencia Late.
18	1·56	6·08	9·27	5·9	5·9	Paramatta.
19	1·26	6·02	8·49	6·7	6·7	Nasinu.
20	·57	6·05	8·80	8·4	8·9	Parson Brown.
Control	·90	6·89	9·64	10·7	10·7	Random.

VITAMIN C OF CITRUS FRUITS.

The vitamin C values of the different fruits are recorded in table below. These values were determined by titration with 2:6 dichlorophenol-indophenol the indicator being standardised against synthetic Vitamin C. The values given indicate that Fiji-grown fruits compare favourably with citrus fruits grown in other countries.

Vitamin C values.

Variety.	Stock.	Vitamin C mgs per 100 ccs. juice.
Jaffa	Sour orange, Trinidad	70·0
Nasinu	Fiji sweet orange, local	76·2
Valencia Late	Fiji sweet orange, local	72·6
Navel	Fiji sweet orange, local	71·6
Paramatta	Fiji sweet orange, local	79·8
Mediterranean Sweet	Rough lemon, local	63·1
Parson Brown	Fiji sweet orange, local	77·9
Krome Davis	Unknown Jamaica	49·8
Marsh	Fiji sweet orange, local	54·9
Duncan	Fiji sweet orange, local	62·3

SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS.

(1) The figures in Tables 2 and 3 show that the present planting distance, 20 ft. by 20 ft. square, is too close and that future plantings should be 24 ft. by 24 ft. square on flat land where mechanical cultivation is used. On hill land, contour planting is, of course, essential, but the trees should be placed at distances not less than 24ft. Furthermore, the wider planting distance would permit more sun and air into the grove and would thereby reduce the incidence of fungi and scale insects.

(2) While some information is available regarding stock-scion relationship, it must be accepted that the investigation is incomplete and requires further study. It is therefore, recommended that trial plantings capable of statistical treatment should be undertaken embracing a wider selection of the recognised stocks, also, that trial should be undertaken on a soil formation where citrus culture is likely to be developed.

(3) The investigation confirms the inadvisability of sweet orange stock owing to its susceptibility to collar-rot and that there is a tendency to incompatibility of certain orange varieties to sour orange stock.

Pending further study of stock-scion relationship it is suggested that the recommended varieties should be multiplied on sour orange, rough lemon and trifoliate stocks for distribution.

(4) The control of minor fungi and insect pests requires routine attention, so that simple practical means may be evolved for their control.

(5) The results of the examination of fruits clearly indicate that both oranges and grape-fruit of excellent quality can be produced in the wet zone and that they are in no way inferior to fruit produced in other citrus producing countries.

(6) Further work is recommended on the varieties Nasinu, Paramatta, Valencia Late, Washington Navel and Mediterranean Sweet, on a series of known stocks. The varieties Jaffa and Parson Brown should be discarded.

(7) A systematic survey of the local orange tree population is indicated by the performance of the control—a random sample of Fiji orange. Such an investigation may result in the isolation of types superior to those now under study.

(8) The grape-fruit varieties Duncan and Marsh are both of excellent quality and their multiplication on sour orange stocks should be continued for distribution.

The writers are indebted to their colleagues for information on the past history of the establishment and to the Plant Pathologist for his assistance in confirming the presence of collar-rot and the recording of the incidence of the disease.

ENTOMOLOGICAL NOTES.

By
R. J. A. W. Lever, B.Sc., D.I.C., A.I.C.T.A., F.L.S.

1. FURTHER NOTES ON THE GREEN VEGETABLE BUG.

SINCE the June issue of the *Agricultural Journal* appeared, some additional work has been done on the green vegetable bug, recently determined by the Imperial Institute of Entomology to be *Nezara viridula* L. var. *smaragdula* F.

In the Suva district it has been recorded on tomato, where its green colour makes it particularly difficult to distinguish on the leaves. The former Entomologist (Mr. H. W. Simmonds, O.B.E.) who has grown tomatoes for the last ten years in Suva, never saw the insect before this year though now it is fairly common.

At the hill-station of Nadarivatu, which is some 2,600 feet up, the present writer took it in July (65°F.) on an introduced purple herb (*Ageratum*) and it has since been taken there both on lettuce and the sow thistle (*Sonchus asper* Hill) by a resident who believes it has been present for two years. This suggests it arrived at a northern port of entry rather than at Suva where it was first recorded this May, though taken at Navuso in the previous December.

In response to the writer's June article, a planter on eastern Vanua Levu kindly sent what proved to be a specimen of this pest—the first record away from Viti Levu. It is believed to have thus reached Buca Bay last year on some vegetables from Suva.

As showing its spread in Australia it may be mentioned that, although recorded in 1911 in New South Wales, it took five years to become a pest in that state and reached South Australia only in 1938. As two writers (1) dealing with its distribution in 1934 do not include New Zealand, it is preferable to doubt Tillyard's record (2) of it in that Dominion in 1926.

The bug probably reached Fiji from Australia which is only a week's sailing as opposed to a fortnight's voyage from the western sea-board of the United States where it also occurs.

Egg-masses laid on the underside of tomato leaves in the laboratory averaged 75 per batch and varied from 51 to 95 in number. They are pale ivory-coloured when laid changing to a darker cream in two days and then orange-yellow with a red arrow-head visible through the cap or operculum. Hatching occurs between the sixth and eighth days after laying and the anchor-shaped egg-burster is visible. These are August figures (66° to 80°F.) and should be a day or two less during the hot season.

Details of the five ecdyses, or changing of the skin during development of the nymph, are as follows:—

1st	instar	lasts	4	to 7	days.
2nd	,,	,,	5	to 6	,,
3rd	,,	,,	7	to 8	,,
4th	,,	,,	6	to 8	,,
5th	,,	,,	10	to 13	,,
		Total	32	to 42	days,

making 38 to 50 days from oviposition to emergence during the cool season.

As this insect is able to withstand frost in New South Wales (3) and yet can cause internal boll rot of cotton in the West Indies it is clearly capable

of thriving anywhere in Fiji. Besides the plants recorded in the last *Journal* it attacks cocoa, ground nuts, artichoke and pawpaw elsewhere in the tropics, and adults were found by the writer to suck fluid from the chrysalis of the leaf-mimic butterfly *Doleschallia bisaltide* Cram. *australis* Feld. a number of which happened to be in the rearing cage: none so attacked emerged.

Experiments made with various sprays proved the resistance of the adult which survived wetting with one part of white oil to twenty parts of water though the recommended concentration for scale insects is one part in forty. Pyrethrum ½ oz. and laundry soap ¼ oz. dissolved in ½ gallon of water gave only a fifty per cent. mortality against adults but is effective against the softer nymphs. Collection and destruction of the yellow egg-clusters is the best method and can be coupled with jarring of the adults into a rough net (of sacking or cloth sewn onto a wire loop inserted into a handle) which is soaked in kerosene.

The writer again appeals to anyone outside of the localities mentioned to send suspected specimens (with the name of the host-plant) attacked of this very destructive insect. He is indebted to the Botanist and Mycologist for indentifying the sow thistle.

(1) Newman, L. J., and O'Connor, B.A. 1924. *Journal Agric. West Aust.* Vo . 11, No. 1.
(2) Tillyard, R. J. 1926. "Insects of Australia and New Zealand." Sydney.
(3) Zeck, E. H. 1933. *Agric Gaz.* of *N.S.W.* Vol. 44, part 8, August.

2. A MOSQUITO HITHERTO NOT RECORDED IN FIJI.

In 1935 Paine published (1) a bulletin describing the sixteen mosquitoes known in the Colony, two of which were new. Practically every imaginable habitat was investigated and his paper represented the culmination of several years intensive collecting in Fiji. The present writer was therefore surprised to find that mosquitoes taken in two buildings (one being an hotel lounge in Suva) on the south coast of Viti Levu last March proved to represent a species not hitherto recorded here. The specimens were identified by Dr. F. W. Edwards of the Imperial Institute of Entomology, London, as *Aedes vigilax* Skuse, which is said (2) to occur round the Australian coast, New Guinea and New Caledonia. As it is known to breed in salt water (3) it is not surprising to find it confined to the coast but the fact that it was not recorded by a serious worker five years ago suggests that it has arrived since then from Melanesia and is now fairly well established.

(1) Paine, R. W. 1935.—"Introduction to the Mosquitoes of Fiji." Department of Agriculture, Fiji. (Unnumbered bulletin.)
(2) Taylor, F. H. 1934.—Service Publication No. 1, School of Public Health and Medicine, University of Sydney, May 25th.
(3) Edwards, F. W. 1932.—Bull. Entom. Resch., Vol. XIII.

3. AEROPLANE TRANSPORT OF INSECT PESTS

In our issue for October, 1939, (Vol. 10, No. 3), attention was drawn to the danger resulting from aeroplane carriage of flies, malarial and yellow fever mosquitoes and other insects to regions hitherto free from such pests.

A timely reminder of the local imminence of such unwanted visitors is given in the *Pacific Islands Monthly* for July 15th in an article entitled "Insect Stowaways" which is reproduced below:—

> "To a growing degree, despite the handicap of war, the Pacific Ocean is being criss-crossed by aeroplane services and, as the aeroplane services

extend, so there increases also the danger of harmful insects being carried from the countries which they infest, to countries which now are free from them.

"There recently arrived in Auckland, on his way to New Caledonia, Dr. F. X. Williams, associate Entomologist at the experimental station of the Hawaiian Sugar Planters' Association. Pan-American Airways is about to run regular services between Hawaii and Auckland, *via* Canton Island and New Caledonia. In order that insect pests may not be transplanted from Auckland, New Caledonia or Canton Island to Hawaii, the scientist is going to have a look at the insect life in those places and ascertain what precautions are necessary.

"Pan-American Airways now run a service between Asia and North America, *via* Hong Kong, the Philippines, Guam, Midway Island,* Wake Island and Hawaii, and it was decided that insect pests from Asia, or the Philippines, should not invade Hawaii, if they could be kept out. The Sugar Planters' Association established an examination station on Midway Island and every aeroplane coming in from Asia is sprayed and examined there. The entomologist in charge already within nine months, has collected several thousand specimens of insects. Most were harmless, but there are some which might have proved injurious to Hawaiian crops, or to the health of the Hawaiian people".

In *The Scientific American* for July (Vol. 163, No. 1) it is pointed out that 10 month's collection of insects from 66 planes which visited Midway Island from Asia contained 1,200 dead and 1,100 live insects. To guard against pests reaching Hawaii from New Caledonia the Hawaiian Sugar Planters' Association has recently co-operated with Pan-American Airways and an entomologist will be sent to lonely Canton (or Mary) Island in the Phœnix group. As it is roughly half way between the two groups of islands concerned, is only 9 miles long by 4½ miles wide (the size of Vatulele) and so bare of plants as to be almost barren it will be an ideal quarantine station for killing potential pests originating from New Caledonia. As Fiji may very soon be included in some future scheme it is well to know what has already been done by Americans to safeguard their Pacific possessions from unwanted insects which could never travel such vast distances except for the advent of the aeroplane.

* These should be transposed as Midway Island is nearer Hawaii.—Editor, *Agricultural Journal.*

NOTES ON WEED IN FIJI—III.

By
B. E. PARHAM, M.A.,
Agricultural Officer (Plant Pathology).

THE following notes refer to weeds which have been sent in for identification or which have been recorded for the first time or noted as being on the increase:—

1. "HIBISCUS BURR", *Urena lobata*, L. (FAMILY MALVACEAE), FIJIAN NAME "QATIMA."

Distribution.—This plant, now called "Hibiscus Burr" by local farmers, is an aboriginal weed throughout Polynesia. It is wide spread in all tropic countries as a weed of waste places and has been cultivated experimentally as a fibre-yielding plant. It is easily recognised by the three to seven-veined leaves and the small pink, *Hibiscus*-like flowers.

In Fiji, during recent years, the spread of this weed has been noticeably rapid at Navua, Korovou, Tailevu and on the banks of the Waidina River, where following the control of Koster's Curse (*Clidemia hirta*) by the introduced thrips, it has become a dominant weed along road-sides and in pastures.

It is distributed by means of the seeds which are enclosed in the bristly, burr-covered carpels which are readily attached to the fur of animals and to clothing.

Botanical description.—A hard erect perennial herb or shrub, 2 to 4 feet high or larger, covered on the stems and underside of the leaves with a whitish, close tomentum. Leaves petiolate, the lower ones nearly orbicular, the upper ones ovate or lanceolate, palmately 3 7 veined, irregularly toothed, angular or broadly and shortly lobed, glabrous above or slightly scabrous, tomentose.

Flowers sessile or nearly so. Petals pink, about 1 inch long or smaller, axillary or in terminal leafy racemes.

Fruit carpels indehiscent, muricate or covered with hooked bristles.

Status as a weed.—Infested areas in Naitasiri and Tailevu provinces have contained by calculation as many as 75,000 plants per acre. The average size of these plants is five feet high, with wide-spreading branches, each of which bears a succession of flowers and fruits throughout the year. At altitudes of 3,000 feet above sea level and on poor land (as " talasiga ") it is reduced to a small size and may not exceed 9 to 12 inches in height.

The root-system is extensive and in many cases the weed occupies the land to the exclusion of all other growth. It is particularly troublesome on light sandy loams and grows best in open situations. It is a serious weed only in neglected or poorly managed pasture or in waste places as road sides and corners of fields.

Control.—As the plant is a woody perennial, adequate control measures are limited. Prevention of infestation of pasture land may be greatly assisted by pasture management aiming to maintain a cover of grass by means of rotational grazing of the fields. This plant is not tolerant of shade and germination takes place in sites exposed to maximum light and sunshine. Valuable results may be achieved by co-operative and concerted action by all land holders in the same neighbourhood: a method of weed control which has proved most satisfactory in the United States of America (1).

PREPARATION OF MATERIAL FOR IDENTIFICATION.

A.—PLANTS AND FUNGI.

An increasing number of plant specimens are being received for study and identification and it is necessary to draw the attention of readers to the following hints for the preparation of such plant material:—

1. *Plants for botanical identification.*

(1) Specimens forwarded should be portions of a typical plant comprising leaves, flowers and fruits (immature and mature).

(2) The specimens should be numbered for reference and should be accompanied by a note as to locality, date of collection, altitude, uses, &c.

(3) Specimens should be carefully dried between sheets of newspaper and forwarded in a package with cardboard stiffener.

2. *Plant diseases.*

(1) In the case of material of plant diseases it is essential that there be no delay in forwarding.

(2) The diseased portions of the plants should be placed in a cardboard box or in a tin together with relevant notes on the extent of infection in the field.

(3) The specimens should be numbered for reference and should be accompanied by a note as to locality, date of collection, &c.

—B.E.P.

B.—INSECTS.

Planters, and other settlers who live away from the vicinity of Suva, wishing to send to the Department of Agriculture specimens of insects damaging their crops or garden plants may find the following information of some use. It is hoped that by its means the material sent may arrive at headquarters in the best condition for examination and subsequent report.

Live insects, such as caterpillars, require both sufficient food and ventilation. The food-plant should be so packed that there is no chance of water leaking from the receptacle holding it while adequate ventilation can be obtained by boring holes in the box or tin if wire gauze cannot be used. Closed tins without some form of ventilation result in fermentation or condensation and this will spoil the contents. A label with "Live insects, immediate delivery," should be affixed. For very short journeys there is clearly less need to take such precautions.

Delicate insects such as aphids, thrips, lice, ants and small flies should be put in small tubes or bottles of methylated spirits, formalin or alcohol. Harder and more robust insects such as beetles, bees and wasps may be packed in tins with carbolic acid or powdered camphor-balls and fine sawdust or cotton wool to prevent injury.

Butterflies are best sent by placing them within rectangular pieces of smooth paper which have been cross-folded into the shape of a triangle and the overlapping edges turned down. Data can be written on these papers.

Scale insects should be kept on the leaf which is then pressed between blotting paper under a heavy weight.

Large moths, stick-insects and grasshoppers should have their viscera removed with a pair of fine scissors and the abdomen filled with cotton wool or the whole specimen may arrive rotten.

Attention should also be given to packing as violent jarring may be expected on a journey in small cutters or schooners—corrugated cardboard and "wood wool" are two of the best substances as shock-absorbers.

While the material is being kept preparatory to shipment it is important to place it out of the reach of ants which in an hour or two may damage the whole collection and make it useless. This precaution is most important.

Accompanying the specimens should be the name of the crop attacked, particulars of the portion so attacked and its age with the date and exact locality. If possible, samples of the damaged tissue should also be sent or a rough sketch if this impossible. Any other information such as abnormal weather, extent and degree of infestation, records of previous outbreaks, other host-plants and so on should be sent.

A long series of specimens is always desirable and care should be taken to see that immature stages only are not sent.

Lastly, always err on the side of overpacking with wood wool or moss.

—R.J.A.W.L.

ABSTRACT.

THE FEEDING OF LIVE STOCK BY H. E. WOODMAN (*concluded*).

(Journal Royal Agriculture Society of England Volume 100, Part 1, 1939.)

II. THE NUTRITION OF CATTLE.

Vitamin supply.—It is reassuring to the farmer to note the ease with which the minimum requirement of calves or cows for carotene and vitamin A may be supplied in the dietary. One ounce of fresh grass is sufficient for a 100 lb calf. Carotene and Vitamin A appear in the butter fat but the amounts never exceed that of normal butter produced on summer pasture, regardless of the total amount consumed. The ratio of carotene to Vitamin A in the butter is roughly constant at 1:2.

Vitamin A in colostrum.—The Vitamin A content of Colostrum (Beastlings) is from 10 to 100 times higher than that of later milk. The quantity is greatest in the first colostrum but falls rapidly to the fourth day. Vitamin A is stored in the liver and the variation in the amount present in the colostrum is influenced by the length of dry period prior to calving.

Vitamin D.—In the absence (experimental) of Vitamin D even adult cows fail in the utilization of calcium and phosphorus and develop rachitic symptoms.

It is now established that solar irradiation of the cow increases the Vitamin D content of milk as does also irradiation with artificial sources of ultra-violet light. (It is unlikely therefore, that a deficiency of Vitamin D would occur in Fiji cows.)

Protein requirements for milk production.—An allowance of 0·6 lb of digestible protein for each gallon of milk produced is essentially a safe standard in computing the ration for milking cows.

Calf rearing.—Where whole milk is the only milk ration available such as would be the position on milk-selling farms, the total amount of whole milk fed may be reduced to between 35–40 gallons providing a suitable supplementary food is provided. It was formerly the practice to feed this supplementary ration in the form of a gruel. It has been found, however, that better results are obtained when the supplementary feed, "calf starter" is fed dry. The method adopted at Cornell University was as follows:—On the first day the calf was left with its mother. The daily allowance of whole milk in the successive seven weeks of feeding were 8, 9, 10, 9, 7, 6, and 4 lb, the milk being eliminated entirely in the 8th week. From 2 weeks of age until the average daily consumption reached 4 lb the dry "calf starter" was fed to the calves in as great a quantity as they could consume.

The dry "calf starter" used was composed of a mixture of 32¼ per cent. yellow maize meal, 28 per cent. of oat meal, 10 per cent. of wheat bran, 5 per cent. of linseed cake meal, 3 per cent. of white fish meal, 20 per cent. of dried skim milk, 0·5 per cent. of steamed bone flour, 0·5 per cent. of ground limestone, 0·5 per cent. of common salt and 0·5 per cent. of cod liver oil concentrate. The total protein content of ration =20·2 per cent. In another group of calves, the foregoing formula was modified by replacing 6 per cent. of maize and 10 per cent. of dried skim milk by 16 per cent. of cereal-yeast feed, a product consisting of a mixture of 20 per cent. of dried brewer's yeast, 60 per cent. of maize gluten feed and 20 per cent of maize germ meal.

As each calf reached a consumption of 4 lb of calf starter, an additional 1 lb of growing mixture was allowed. This mixture contained 13 per cent. of protein and consisted of 25 per cent. of wheat bran, 25 per cent. of maize, 14 per cent. of barley, 10 per cent. of oats, 10 per cent. of linseed cake meal,

14 per cent. of cane molasses and 1 per cent. each of bone meal and common salt. Lucern and clover hay, in addition to grass was fed *ad lib* beginning at 2 weeks of age.

Under the first mentioned ration, at 16 weeks the calves made growth equal to 113 per cent. and under the second mentioned ration 142 per cent. of the growth that is considered normal.

(Whilst these feeding trials illustrate the possiblities of calf raising with a reduced whole milk ration, the same formulas cannot as yet be used in Fiji owing to lack of the necessary food stuffs. A modified formula containing food stuffs locally available is being worked out.)

Sprouted maize in the ration of fattening cattle.—Swede turnips, a commonly used fodder for fattening cattle was used as a basis for comparison. When 30 lb of swedes were replaced by 13½ lb of sprouted maize there could be no doubt of the influence of the latter in accelerating the rate of live weight increase of the cattle. It is thought that there may be present in sprouted maize some special factor that exerts a specific beneficial effect on the metabolism of animals.

NUTRITION OF SHEEP.

Prominence has been given in recent years to the necessity of the presence of traces of cobalt in the ration of sheep to prevent or cure certain diseases of sheep known as "pine" in England, Enzootic Marasinus and Coast disease in Australia, and bush sickness in New Zealand. As little as 1 mg cobalt per head for 14 days protects sheep for six months on severe "pining" land.

A copper deficiency has been found to be the cause of a disease of lambs in England known as "Swayback."

(These observations serve to illustrate the necessity of providing sheep with a mineral mixture designed to provide against deficiencies in the above mentioned elements.)

In regard to worm infestation in sheep it has become an established fact that well nourished lambs show a greater resistence to worm infestation than do lambs on a lower plane of nutrition. —C.R.T.

LETTER TO THE EDITOR,

The Editor,
Agricultural Journal,
Department of Agriculture.

Forest Department,
17th July, 1940.

Dear Sir,

Dr. Jack's stimulating article, in the *Agricultural Journal* dated June, 1940, clearly indicates a number of directions in which local primary producers could profitably assist the Colony to become self-supporting. With his contentions that there is ample scope for a greater production of essential foodstuffs I have no quarrel: but I must take up the cudgels on behalf of our already ill-treated forests when, on pages 33 and 35 he states, and repeats, that imported timber could readily be replaced by a local product with advantage to the Colony.

This is an opinion which is widely held in Fiji. I should be grateful, therefore, if you would permit me, through the courtesy of your columns, to put forward an alternative point of view.

This Colony produces something like 4 million superficial feet of timber annually, and in so doing destroys between one and two thousand acres of its best forests. During the past 40 years we have imported timber (mostly Orego from Canada) to an extent also averaging about 4 million superficial

feet annually. Thus, instead of deploring our present situation, we should be thankful that the prodigal outlook of the inhabitants of the Pacific seaboard has enabled us, during that period, to draw upon their forests thereby saving some fifty thousand acres of our own for future use.

It can be argued, of course, that if the milling of timber inevitably destroys the parent forest there is little or no advantage to be gained from postponing its exploitation, and that we should, therefore, use our indigenous timbers now and leave the future to look after itself. That proposition cannot, however, be maintained.

I have recently tried to show (in the Annual Report of the Forest Department for 1939) just what steps are required to reconcile not only the perpetuation of our forests, but also their improvement, with deliberate timber working. Those steps need not be examined now except in so far as is necessary to show (*a*) that they embrace cultural operations in the forest extending over a period estimated to last for five years, and, (*b*) that an essential feature is that they must be completed *before* timber working is permitted and not *afterwards*. In the light of this statement it will be observed that the cultural operations being carried out this year by the Forest Department are directed towards those areas which will be logged in the year 1945. We are, therefore, faced, at the start, with a handicap period of 5 years. Very little can be done to safeguard areas worked during this initial period and they must continue to be destroyed as they have been in the past.

From this unavoidably lengthy explanation there will, I hope, emerge the fact that any increase in local timber production must be foreseen, and acted upon, 5 years in advance if waste is to be avoided. It cannot, therefore, be in the best interests of the Colony to encourage any immediate increase in local timber production since it can only be achieved at the expense of an increased destruction of our forest resources.

Yours faithfully,

J. S. SMITH,
Conservator of Forests.

The above letter appears to hinge on the interpretation of the word "readily," which, in the opinion of the writer of the article, does not mean "rapidly."—H.W.J.

EXTRACTS.

GRASS AS HUMAN FOOD.

It has been established after four years of experimenting by Drs. G. O. Kohler, W. R. Graham and C. F. Schnabel of Kansas City, Missouri, U.S.A., that grain grasses contain all the chief vitamins, except vitamin D, and that their total content of vitamins is actually twenty-eight times as large as that of vegetables or dried fruits. In order to make the grain grasses fit for human consumption as an article of diet, the young blades are dried, bleached and finely ground to powder. Either wheat, barley, oats or rye is used. The cost in U.S.A. is six cents per pound and three factories are engaged in the manufacture of grass powder. It is claimed that the use of only twleve pounds of dried grass per year per head of population will provide the necessary accessory growth factors for a liberal diet at a very low cost.

—*Tropical Agriculture*, Volume XVII, No. 7, July 1940.
—H.W.J.

NATIONAL DIETARY.

("Nature," Volume 145, No. 3674, March 30, 1940, page 476-477).

FEW will be prepared to dispute Sir John Orr's contention that, owing to the relatively high cost of the protective foods, about a third of the population of Great Britain suffer from some degree of malnutrition. This fact was established in "Food, Health and Income" and is confirmed by more recent dietary surveys. This being the case, it is not possible to disagree with Sir John's further contention that, in order to ensure the solidity of our national effort, not only must the national dietary be maintained on a satisfactory basis, but also steps must be taken actually to improve the diet of the poorest third of the population. To achieve this end Sir John Orr and Mr. Lubbock propose to adopt for food the more gerenal proposals for an "iron ration" suggested by Professor J. R. Hicks and commended by Mr. J. M. Keynes. They propose that adequate supplies of a limited number of foodstuffs, selected on grounds of health and availability, should be sold at prices which would ensure that the poorest 10 per cent. of the community, who may not have more than 4s. 6d. a head to spend upon food, should be enabled to purchase their full requirements of these foodstuffs at a price of not more than 3s. a head a week; thus leaving 1s. 6d. a head to spend according to their tastes on other foods. It is tentatively suggested that the following foods should be selected; milk, potatoes, oatmeal, vegetables, bread, sugar and either butter or vitaminized margarine. It is maintained that, provided everyone could obtain full supplies of these seven foods, there would be no shortage of vitamins, and calcium requirements would be fully met, as well as those for other minerals. Of these foods four, namely milk, potatoes, oatmeal and vegetables, could be wholly produced in Great Britain. There is no suggestion that imports should be limited to wheat, sugar and fats, but rather that these three essentials, together with perhaps cheese and dried fruits, should be given priorty on shipping space so that stocks could be built up in the country.

It is of vital importance that the policies of the British Government in regard to food and to agriculture should be so closely correlated as to be, in effect, complementary parts of the same policy.

A simple method of ensuring the fullest possible production of milk, potatoes and vegetables is proposed. Farmers would be offered guaranteed markets at attractive prices for these products, not only for the war, but also for at least a three-year period after the war. This method would secure the aims sought, provided steps are simultaneously taken to discourage, by less attractive prices, an undue concentration upon cereal production or the feeding of imported concentrates to fatten cattle and sheep.

—H.W.J.

SOYA BEAN OIL AS FUEL.

JAPANESE engineers are reported to have carried out experiments in running a diesel engine using soya bean oil as fuel. It was found that, as compared with mineral oil, fuel consumption was higher, but this was compensated to a great extent by easier starting, less diesel knock, and smaller initial lag. Output and thermal efficiency were found to be nearly balanced.

—(*Crown Colonist*, August, 1940.)

FLAX.

WORLD production in 1938 was 806,000 tons per annum of which the British Empire only produced 8,000 tons or less than 1 per cent. of the world crop.

The United Kingdom imports approximate in peace time to 70,000 tons of which only 10 per cent was grown in the Empire. The average price of Belgian water-retted flax in London in 1938 was £111 per ton. Flax is required for thread, twine, canvas yarn, &c.

Average yields of flax straw per acre in Victoria in 1938 were 34 cwt., which would give 10 to 15 per cent. of treated fibre.

RAINFALL AND MEAN TEMPERATURE AT SUVA, 1939.

	Inches of rain.	*Mean temperature.*
January	30·71	79·9°F.
February	5·71	81·1
March	23·06	79·0
April	16·98	77·9
May	22·88	76·0
June	2·07	74·2
July	6·53	72·9
August	6·55	74·5
September	6·25	74·2
October	8·63	76·6
November	10·82	76·3
December	6·96	77·7
Total	147·15 in.	76·7° average.

Average rainfall for 54 years is 120·68 inches.

Data recorded by Harbour Master, Suva.